

**FUTURE FISHERIES IMPROVEMENT PROGRAM
GRANT APPLICATION***(please fill in the highlighted areas)***I. APPLICANT INFORMATION**

A. Applicant Name: Jason Mullen

B. Mailing Address: 4600 Giant Springs Road

C. City: Great Falls State: MT Zip: 59405

Telephone: 406-454-5855 E-mail: jmulen@mt.gov

D. Contact Person: Jason Mullen

Address if different from Applicant: _____

City: _____ State: _____ Zip: _____

Telephone: _____ E-mail: _____

E. Landowner and/or Lessee Name (if other than Applicant): Amax Exploration, Inc.

Mailing Address: C/O Freeport-Mcmoran Copper & Gold, 333 N Central Ave, Attn: L&W Dept, 24th FL

City: Phoenix State: AZ Zip: 85004-2306

Telephone: 602-366-8100 E-mail: fcx_communications@fmi.com

II. PROJECT INFORMATION*

A. Project Name: Carpenter Creek Barrier Construction

River, stream, or lake: Carpenter Creek

Location: Township: 14N Range: 08E Section: 20

Latitude: 46.960880 Longitude: -110.727155 *within project (decimal degrees)*

County: Cascade

B. Purpose of Project:

Construct a barrier to isolate two non-hybridized populations of westslope cutthroat trout from invasion by nonnative fish species.

C. Brief Project Description:

Carpenter Creek is a small 2nd order stream that enters Belt Creek just downstream of Neihart, MT. The Carpenter Creek drainage currently supports two non-hybridized populations of WCT. Mainstem Carpenter Creek contains a robust non-hybridized population that occupies 1.5 miles of stream upstream of Squaw Creek. Haystack Creek is a small tributary to Carpenter Creek and supports a small (less than 20 spawning pairs) non-hybridized population of WCT. Both of these populations became isolated from Belt Creek over 60 years ago when mining resulted in a stream reach incapable of supporting fish because of poor water quality, extending from Squaw Creek down to the confluence of Carpenter Creek and Belt Creek. These two populations are genetically distinct and important in terms of genetic conservation. Current and future efforts to clean up the mine will have the unwanted impact of removing the current chemical barrier that isolates the native WCT from nonnatives in Belt Creek. Removal of this chemical barrier will ultimately result in increased competition and hybridization with invading nonnatives. Monitoring efforts in 2014 and 2015 in Carpenter Creek found several rainbow trout in lower Carpenter Creek near the confluence with Belt Creek, where no fish had been observed from 2011 through 2013. Given the future loss of the chemical barrier, a plan was developed to construct a fish barrier on Carpenter Creek. In December 2013, \$16,000 was awarded by PPL Montana (now Northwestern Energy) to hire an engineer to evaluate the best potential sites for a barrier and design the barrier. The best site location was determined to be on Amax Exploration, Inc property, just downstream of Snow Creek (Figure 1), and the design for the barrier was completed in February 2015. MFWP is requesting additional funding to hire a contractor to construct the barrier to ensure the non-hybridized WCT populations remain isolated. Once the barrier is complete, an additional 1.6 miles of habitat will be available in Carpenter Creek for WCT (Squaw Creek to barrier site) as water quality conditions improve from mine cleanup activities. This is in addition to the 1.5 miles of stream in Carpenter Creek and the Haystack Creek populations of WCT that are already present, and will protected by the completion of the barrier, or lost if the barrier is not completed.

This project is unique compared to many other barrier construction projects in that a non-hybridized population currently resides upstream of the chemical barrier. As such, as long as the barrier is constructed before the chemical barrier is lost; no additional and costly restoration activities (e.g., piscicide treatments) will be needed.

Discussions with Amax Explorations, Inc., US Forest Service (adjacent landowner), and MFWP are underway to determine final construction and ownership details. No problems with construction, ownership, or maintenance are anticipated at this time.

Figure 1 illustrates the location of the barrier site on Carpenter Creek.

D. Length of stream or size of lake that will be treated:

The barrier site will be located 1.6 miles upstream from the confluence with Belt Creek. The amount of impact to the streambanks will be localized to the footprint of the barrier. An estimated 115 ft of stream will be inundated upstream during a 50 year flow event.

Completion of the barrier will protect 3.1 miles of WCT habitat (1.5 miles already occupied and 1.6 miles to be repopulated with improving water quality) in Carpenter Creek, as well as the small population in Haystack Creek.

E. Project Budget:

Grant Request (Dollars): \$ 80,000

Contribution by Applicant (Dollars): \$ _____ In-kind \$ _____
(salaries of government employees are not considered as matching contributions)

Contribution from other Sources (Dollars): \$ 85,000 for construction +
16,000 already awarded for
design In-kind \$ _____
(attach verification - See page 2 budget template)

Total Project Cost: \$ 174,928 (cost estimate for barrier construction)

F. Attach itemized (line item) budget – budget attached. Budget is based on the engineer's cost opinion, including 10% construction contingency.

G. Attach specific project plans, detailed sketches, plan views, photographs, maps, evidence of landowner consent, evidence of public support and fish biologist support, and/or other information necessary to evaluate the merits of the project. If project involves water leasing or water salvage complete supplemental questionnaire (fwp.mt.gov/habitat/futurefisheries/supplement2.doc).

See attached Technical Memo for the Carpenter Creek Barrier Construction Hydraulic Analysis, which includes plans and specs.

Basic dimensions of the barrier include;

- Width of Weir Opening – 16 ft
- Weir Notch Height – 5.5 ft
- Structure Width – 62.5 ft
- Barrier Weir Crest Elevation – 5,880.5 ft

H. Attach land management and maintenance plans that will ensure protection of the reclaimed area. No land management or maintenance plans apply. However, periodic monitoring of the westslope cutthroat trout population upstream of the barrier will be conducted after construction of the barrier. Periodic inspection and maintenance of the barrier will be conducted on an as-needed basis.

III. PROJECT BENEFITS*

- A. What species of fish will benefit from this project?:

Westslope cutthroat trout (*Oncorhynchus clarkii lewisii*)

- B. How will the project protect or enhance wild fish habitat?:

Construction of the barrier will isolate non-hybridized westslope cutthroat trout from possible invasion by non-native fish as water quality conditions improve from mine cleanup activities.

- C. Will the project improve fish populations and/or fishing? To what extent?:

Construction of the barrier will preserve the genetic integrity of the non-hybridized westslope cutthroat trout. As water quality conditions improve from mine cleanup activities, an additional 1.6 miles of stream from Squaw Creek down to the barrier will become available for repopulation by westslope cutthroat trout. This is in addition to providing protection for the 1.5 miles of Carpenter Creek already occupied by WCT and the population that resides in Haystack Creek.

- D. Will the project increase public fishing opportunity for wild fish and, if so, how?:

At a minimum the project will maintain the current fishing opportunities for westslope cutthroat trout. If the project does not happen, this opportunity for fishing for westslope cutthroat trout in Carpenter Creek will be lost. With a barrier in place, and as water quality conditions improve, an additional 1.6 miles of stream in Carpenter Creek will become available for repopulation by westslope cutthroat trout, increasing fishing opportunities for a native wild fish.

- E. The project agreement includes a 20-year maintenance commitment. If you are unable to meet this commitment, please explain why:

Periodic maintenance will be conducted on the barrier by MFWP as needed over the 20 year commitment and beyond.

- F. What was the cause of habitat degradation in the area of this project and how will the project correct the cause?:

Ongoing and future mine cleanup activities will result the loss of the current chemical barrier that isolates westslope cutthroat trout in the Carpenter Creek drainage from nonnative fish in Belt Creek. Construction of this barrier will maintain the isolation, preserving the non-hybridized populations of westslope cutthroat trout.

- G. What public benefits will be realized from this project?:

Two populations of Montana's state fish, the native westslope cutthroat trout will be preserved for future generations. As water quality conditions improve from mine cleanup activities and additional 1.6 miles of stream will become available for westslope cutthroat trout to repopulate.

- H. Will the project interfere with water or property rights of adjacent landowners? (explain):

No. No water rights or property of adjacent landowners will be affected. All impacts of the project will be isolated to the property owner. No impacts to the adjacent landowner are expected. The adjacent landowner is the US Forest Service, which is a partner on the project.

- I. Will the project result in the development of commercial recreational use on the site?: (explain):

No. The project is located on private land. No commercial recreational use is expected in this remote area.

J. Is this project associated with the reclamation of past mining activity?:

Yes. The need for building this barrier is because ongoing and future cleanup of past mining activities will result in improved water quality, eliminating the current chemical barrier that prevents upstream invasion by non-natives.

Each approved project sponsor must enter into a written agreement with the Department specifying terms and duration of the project.

IV. AUTHORIZING STATEMENT

I (we) hereby declare that the information and all statements to this application are true, complete, and accurate to the best of my (our) knowledge and that the project or activity complies with rules of the Future Fisheries Improvement Program.

Applicant Signature:



Date:

11/24/2015

Sponsor (if applicable):

***Highlighted boxes will automatically expand.**

**Mail To: Montana Fish, Wildlife & Parks
Habitat Protection Bureau
PO Box 200701
Helena, MT 59620-0701**

**E-mail To: Michelle McGree
mmcgree@mt.gov
(electronic submissions MUST be signed)**

**Incomplete or late applications will be returned to applicant.
Applications may be rejected if this form is modified.**

*****Applications may be submitted at anytime, but must be received by the Future Fisheries Program office in Helena before December 1 and June 1 of each year to be considered for the subsequent funding period.*****

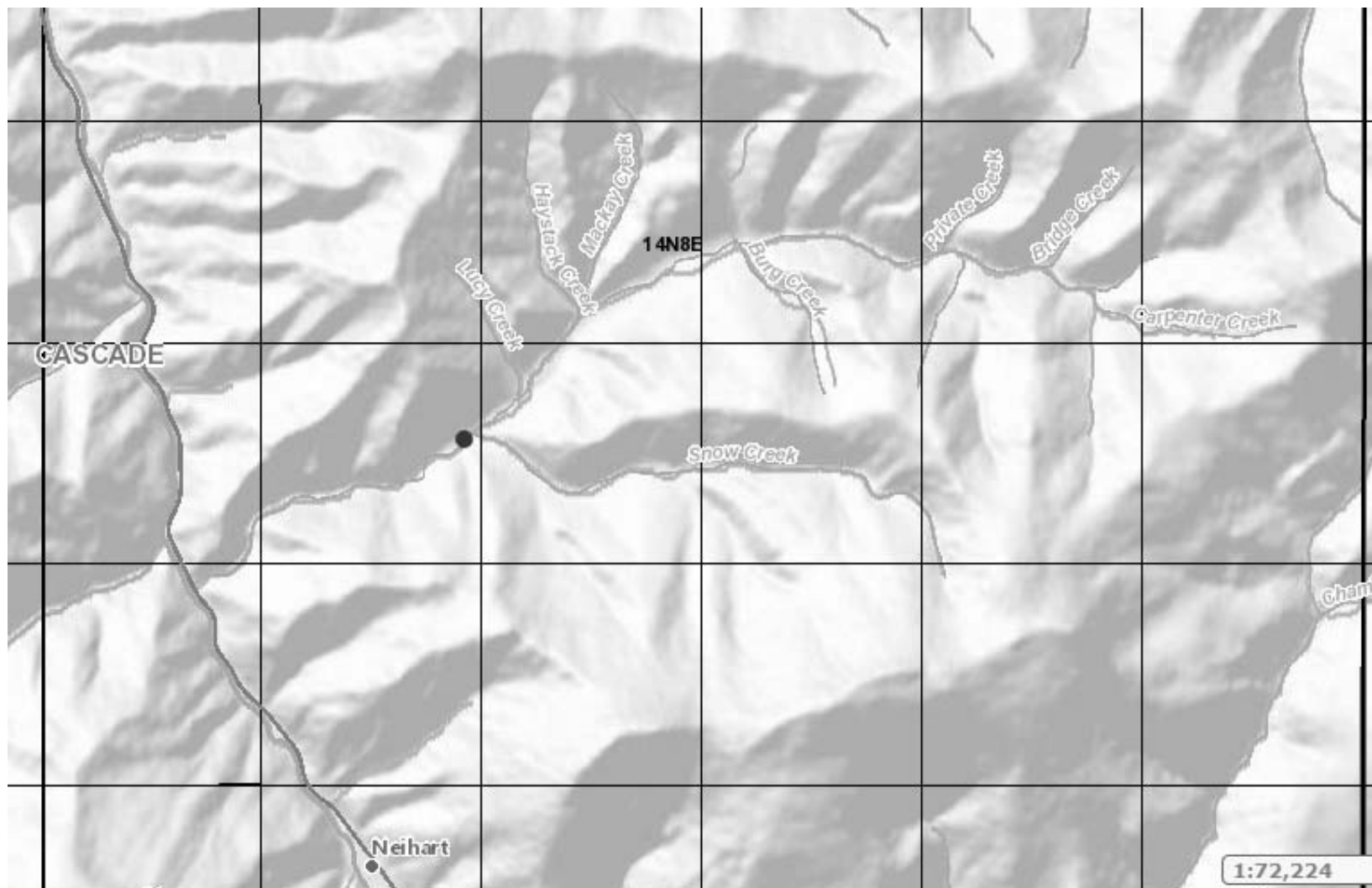


Figure 1. Map of Carpenter Creek. Barrier site indicated by red dot.

BUDGET TEMPLATE SHEET FOR FUTURE FISHERIES PROGRAM APPLICATIONS

Both tables must be completed or the application will be returned

WORK ITEMS (ITEMIZE BY CATEGORY)	NUMBER OF UNITS	UNIT DESCRIPTION*	COST/UNIT	TOTAL COST	CONTRIBUTIONS			
					FUTURE FISHERIES REQUEST	IN-KIND SERVICES**	IN-KIND CASH	TOTAL
<u>Engineer's Cost Opinion of Carpenter Creek Barrier Construction</u>								
Mob/Demob	1	lump sum	\$11,879.75	\$ 11,879.75				
Bonding	1	lump sum	\$12,803.98	\$ 12,803.98				\$ -
Clearing, Grubbing, and Demolition	1	lump sum	\$4,160.00	\$ 4,160.00				\$ -
Water Management	1	lump sum	\$20,000.00	\$ 20,000.00				\$ -
Structure Construction	1	lump sum	\$87,000.00	\$ 87,000.00	80,000.00			\$ 80,000.00
Reclamation and Revegetation	1	lump sum	\$5,000.00	\$ 5,000.00				\$ -
Construction Contingency- 10%	1	lump sum	\$14,084.00	\$ 14,084.00				\$ -
Construction Oversight	1	lump sum	\$20,000.00	\$ 20,000.00				\$ -
			Sub-Total	\$ 174,927.73	\$ 80,000.00	\$ -	\$ 85,000.00	\$ 165,000.00

MATCHING CONTRIBUTIONS (do not include requested funds)

CONTRIBUTOR	IN-KIND SERVICE	IN-KIND CASH	TOTAL	Verified? (Y/N)
Norwestern Energy - Design - Already Funded**		16,000.00	\$ 16,000.00	Y
Norwestern Energy (request submitted Dec 1, 2015)	\$ -	\$ 80,000.00	\$ 80,000.00	N
Pat Barnes Chapter Trout Unlimited	\$ -	\$ 500.00	\$ 500.00	N
Missouri River Flyfishers Chapter Trout Unlimited	\$ -	\$ 500.00	\$ 500.00	N
Montana Trout Unlimited (through chapter mini grants)	\$ -	\$ 4,000.00	\$ 4,000.00	N
	\$ -		\$ -	N
TOTALS	\$ -	\$ 101,000.00	\$ 101,000.00	



P.O. Box 3445, Butte, MT 59702
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Technical Memorandum

To: Keith Large (MT DEQ)
David Moser (MT FWP)
From: George Austiguy (Pioneer)
Cc:
Date: 2/17/2015
Re: Carpenter Creek Fish Barrier Hydraulic Analysis

Objective

As part of the native Cutthroat Trout restoration efforts, a fish barrier on Carpenter Creek located inside the Carpenter-Snow Creek Mining District (CSCMD) Superfund Site in Cascade County, Montana is being considered by Montana Fish Wildlife and Parks (MFWP). The barrier would serve to create a permanent barrier to upstream fish travel. This memorandum documents the hydraulic analysis and presents the analysis data, calculations and site discussion of the proposed fish barrier location. Figure 1 shows the project location.

Design Criteria

The fish barrier design concept used in this analysis is based on NOAA Fisheries guidelines and are summarized here:

- Minimum weir height relative to the maximum apron height equals 3.5 ft;
- Minimum downstream apron length shall be 16 feet;
- Minimum downstream apron slope shall be 16H:1V; and
- The downstream apron crest elevation is elevated above the downstream design water surface elevation minimum 1 foot;
- The structure shall exclude fish up to the 50-year recurrence interval flow and remain structurally stable up to a 100-year recurrence interval flow; and
- Structure inundation and barrier construction will maintain a minimum 10 feet buffer from the road

Methods

Pioneer Technical Services (PTS) first visited the site with MFWP, Montana Department of Environmental Quality (MDEQ) and Lewis and Clark National Forest (LCNF) personal in September 2014 to identify a preferred location for the fish barrier. Within the potential barrier site stream reaches, Carpenter Creek can generally be described as having a bedrock foundation with a step-pool geomorphology and limited

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406 203-0691

flood plain. A gravel road is located to the north of the stream channel, to the south the stream channel is bounded by an older terrace and steep upland topography. Photo 1 and Photo 2 shows the proposed site location.



Photo 1: Looking Upstream from Proposed Barrier Site

Topographic and bathymetric survey data was collected on October 14, 2014. The topographic and bathymetric data was used to create a digital terrain model (DTM) of the site area.



Photo 2: Looking Downstream at Proposed Barrier Site

Carpenter Creek is located in an ungaged watershed. Therefore flood frequency estimates were developed using regional regression techniques as described in:

“Methods for Estimating Flood Frequency at Ungaged Sites in Montana”, (Water-Resources Investigations Report 03-4308). This report developed three sets of equations for the region based on:

1. Basin and Climatic Characteristics,
2. Active-Channel Width, and
3. Bankfull Width

The flood frequency values were estimated using an on-line calculator that can be accessed at:

http://mt.water.usgs.gov/freq?page_type=gen_stats_1

Carpenter Creek is located in the Upper Yellowstone region. The calculation methods chosen for this analysis was “Weighted estimate based on Basin and Climatic Characteristics, Active-Channel Width, and Bankfull Width”.

Inputs required for calculation method described above include:

1. Drainage area in square miles;
2. Percentage of basin above 6,000 feet;
3. Width of the Active channel in feet, and
4. Width of the bankfull channel in feet.

The drainage area for the proposed site is 9.17 square miles , the percent of the basin above 6,000 feet is 99% (Figure 2), The active channel width is 20 feet (based on surveyed topography) and the bank full channel width is 27 feet (based on surveyed topography and field observations),

Using the data and methods above, a flood frequency estimate for each of the three sets of regression equations as well as a combined weighted estimate of the three calculation methods was calculated. The combined weighted estimate was the flood frequency estimate used in this analysis because that method had the lowest standard error of prediction for the 50 and 100 year return intervals.

Hydraulics

The site DTM was used to construct a gradually varied flow hydraulic model (HEC-RAS) for the project reach. This site HEC-RAS model was used to simulate the existing and proposed condition stream hydraulics. Figure 3 shows the reach evaluated with the HEC-RAS cross-section locations identified.

The existing condition HEC-RAS hydraulic model was run with the 50-year flow event (356 cfs) as a baseline for the proposed fish barrier design. Roughness value of between $n = 0.04$ and 0.065 were used for the channel and $n = 0.1$ was used for the overbank areas. These n values were chosen using the HEC-RAS Reference Manual for natural streams (D. "Natural Streams", b. "Mountain streams, no vegetation in channel, banks usually steep, trees and brush along banks submerged at high states", 1. "Bottom: cobbles with large boulders" and D-2. "Flood Plains", d. "Trees" 5. "Heavy stand of timber, a few down trees, little undergrowth").

The fish barrier proposed condition hydraulics were simulated to size the barrier geometry and estimate upstream inundation impacts. To determine the downstream apron crest design elevation, a maximum channel roughness estimate was used to produce sub-critical flow conditions (which will produce higher water surface elevations), providing a conservative estimate for the downstream 50-year water surface elevation.

The barrier weir geometry (width and depth) was set using the HEC-RAS inline structure modeling method since it more accurately calculates upstream water surface elevations. Proposed downstream apron velocities and hydraulic conditions were modeled using the cross-section method since it is more accurate in estimating flow conditions downstream of the weir.

Results

Hydrology

Results for the 2, 5, 10, 25, 50, and 100 year return interval can be found in Table 1 below. Detailed calculation results are provided in Appendix A.

Table 1 – Flood Frequency Results

RECURRENCE INTERVAL (yrs)	DISCHARGE (cfs)	STD ERR OF PREDICTION (%)	90% PRED. INTERVAL	
2	160	66.6	58.6	438
5	248	52.4	109.3	561
10	294	51.3	131.7	654
25	334	52.1	148.1	754
50	356	53.9	153.8	823
100	379	56.5	158.4	908

Hydraulics

Using the HEC-RAS model described previously, the fish barrier hydraulics were evaluated for $Q_2 = 160$ cfs, $Q_{50} = 356$ cfs and $Q_{100} = 379$ cfs. The specific location of the barrier structure was iteratively adjusted to minimize upstream impacts and optimize barrier geometry. The existing 50-year water surface elevation at the proposed downstream apron crest was estimated to be approximately 5,875 feet. The design apron crest elevation of 5,876 feet was used to meet the design criteria of 1 foot above the 50-year downstream water surface.

The first channel step crest below the proposed fish barrier is approximately 15 feet downstream of the barrier apron crest. Survey data shows this step to be between elevations 5,970.6 to 5,971.9. The proposed condition was simulated (model geometry: CarpCreekPropSectionsRib) with this step set at minimum elevation of 5971.5.

Model simulations included:

- Existing condition (including sensitivity analysis of water surface to a range of channel roughness)
- Proposed barrier with inline weir (estimate the upstream backwater)
- Proposed barrier with geometric sections (evaluate apron velocities and downstream erosion protection)

Modeling results indicate a fish barrier 62.5 foot wide (including key in on road side) with a 16 foot wide, 5.5 feet tall weir opening will meet the design conveyance criteria. The dimensions are summarized in Table 2.

Table 2 – Fish Barrier Design Summary

Width of Weir Opening (ft)	Weir Notch Height (ft)	Structure Width (ft)	Barrier Weir Crest Elevation (ft)
16	5.5	62.5	5,880.5

The structure top will be placed at an elevation of approximately 5,886 feet providing approximately 1-foot of freeboard above the estimated Q_{100} water surface elevation. The structure crest will be approximately 15.4 feet above the channel invert. The weir crest will be placed at an elevation of 5880.5 feet and will be approximately 10.0 feet above the channel invert.

Downstream channel bank armor riprap sizing calculations for the 100-year flow, were conducted (model geometry: CarpCreekPropSections) using the Army Corp of Engineers Bank Riprap Sizing Method (USACOE) and Highway Research Board Riprap Sizing Method (HRB). The calculations indicate the following rock sizes:

Channel Bank USACOE Method	D_{30} Maximum = 3.3 feet
Channel Bank HRB Method	D_{50} Maximum = 5.6 feet

Due to the large riprap size required, the proposed structure will include cast in place concrete wing walls downstream of the barrier apron to provide channel bank erosion protection (unless competent bedrock is encountered along the channel banks).

To estimate the downstream extent of the required channel erosion and scour protection, a water jet calculation was performed to estimate the horizontal distance the flow jet projects from the downstream face of the fish barrier apron. Two methods were used for the projection calculation, the Bryant-Stratton Method and Chow Open Channel Hydraulic Method. The results are as follows:

Bryant-Stratton	= 11.0 feet
Chow Open Channel Hydraulics	= 12.6 feet

Based on these calculations the erosion protection will extend a minimum 15 feet downstream of the apron.

To determine the structure downstream scour protection, downstream impingement velocities were estimated using BOR impingement velocity estimate methods (Bureau of Reclamation, Fish Protection at Water Diversions, 2006). Downstream flow impingement velocities range between 19.3 and 25.8 ft/sec. Using these velocities in the BOR riprap sizing method (Abt et.al, 1988), the D100 stone size estimates are 2.5 to 4.5 feet with a factor of safety of 1.1.

The estimated water jet impacts the downstream water surface upstream of the estimated downstream hydraulic jump. Therefore the step backwater will not inundate the plunging water jet during the 100-year flow. The channel armor will be specified to be D100 of 4.5 feet, unless competent bedrock is encountered during excavation.

Inundation mapping indicates the 50-year water surface elevation maintains a minimum 10 feet offset from the road and buried telephone line. Therefore, no upstream utilities or infrastructure are estimated to be impacted by the backwater.

Plan, profile and cross section geometry for the proposed fish barrier are shown in Figures 4 and 5. Water surface elevation estimates for $Q_2 = 160$ cfs, $Q_{50} = 356$ cfs and $Q_{100} = 379$ cfs are summarized in Table 3, Table 4 and Table 5. Inundation mapping for Q_2 and Q_{50} are shown in Figure 6. Table 3, Table 4 and Table 5 data provide the inline structure model results upstream of the weir and the geometric model results downstream of the weir.

The final proposed condition model includes a channel downstream step crest elevation of 5,871.5 feet and wing walls. The channel downstream step crest at 5,871.5 feet induces a hydraulic jump to reduce flow energy before discharging over the step to the downstream channel.

Detailed hydraulic output is provided in Appendix A for the existing and proposed condition. Output using an inline structure (model geometry: CarpCreekUpdatedPost) to set the upstream water surface and output using geometric sections (CarpCreekPropSectionsRib) to estimate the apron velocities and downstream conditions are provided in Appendix A.

Table 3 - 2 Year Flow		
River Sta	Existing W.S. Elev (ft)	Proposed W.S. Elev (ft)
477.06	5893.42	5893.42
451.37	5892.33	5892.33
401.95	5890.82	5890.82
378.19	5890.18	5890.18
319.38	5887.66	5887.66
279.3	5886.34	5886.34
271.9	5886.27	5886.27
263.24	5885.67	5885.68
257.83	5885.6	5885.61
231.31	5884.26	5884.25
219.29	5883.4	5883.41
213.08	5882.34	5882.34
205.68	5883.02	5883.11
203.25	5883	5883.09
201.64	5882.96	5883.05
196.59	5882.36	5882.81
189.88	5880.71	5882.9
184.22	5879.1	5882.95
174.43	5877.84	5882.95
169.52	5876.88	5882.95
162.35	5876.84	5882.95
156	5876.31	5882.95
149.7	5876.05	5882.95
141.2	5875.68	5882.95
128.54	5874.97	5882.95
117.73	5874.1	5882.95
111.49	5873.86	5882.95
109.49	5873.9	
108.49	5873.93	5877.57
100.49	5873.82	5877.08
92.49	5873.42	5876.58
91.48	5873.18	5871.97
77.04	5872.33	5871.98
75.55	5871.59	5871.51
62.43	5871.37	5871.37
57	5870.34	5870.33
51.46	5870.41	5870.41
41.23	5870.19	5870.19
29.3	5869.5	5869.5
10.15	5868.26	5868.26

Table 4 - 50 Year Flow		
River Sta	Existing W.S. Elev (ft)	Proposed W.S. Elev (ft)
477.06	5894.26	5894.26
451.37	5893.13	5893.13
401.95	5891.91	5891.91
378.19	5891.23	5891.23
319.38	5888.76	5888.76
279.3	5887.66	5887.65
271.9	5887.56	5887.56
263.24	5886.79	5886.81
257.83	5886.74	5886.76
231.31	5885.26	5885.23
219.29	5884.49	5884.51
213.08	5883.26	5884.64
205.68	5884.16	5884.68
203.25	5884.1	5884.65
201.64	5884	5884.61
196.59	5883.29	5884.53
189.88	5881.64	5884.62
184.22	5879.57	5884.66
174.43	5878.37	5884.67
169.52	5877.52	5884.67
162.35	5877.71	5884.67
156	5877.12	5884.67
149.7	5876.9	5884.67
141.2	5876.62	5884.67
128.54	5876.34	5884.67
117.73	5875.21	5884.66
111.49	5875	5884.65
109.49	5875.05	
108.49	5875.08	5878.17
100.49	5875.02	5877.65
92.49	5874.67	5877.13
91.48	5874.26	5874.96
77.04	5873.19	5874.15
75.55	5872.51	5873.2
62.43	5872.46	5872.46
57	5871.28	5871.81
51.46	5871.21	5871.37
41.23	5871.11	5871.1
29.3	5870.37	5870.38
10.15	5869.23	5869.22

Section(s) used to set apron crest @ 5876

Table 5 - 100 Year Flow		
River Sta	Existing W.S. Elev (ft)	Proposed W.S. Elev (ft)
477.06	5894.34	5894.34
451.37	5893.21	5893.21
401.95	5892.01	5892.01
378.19	5891.32	5891.32
319.38	5888.87	5888.87
279.3	5887.77	5887.77
271.9	5887.67	5887.67
263.24	5886.91	5886.91
257.83	5886.85	5886.85
231.31	5885.34	5885.35
219.29	5884.59	5884.59
213.08	5883.34	5884.8
205.68	5884.28	5884.84
203.25	5884.22	5884.82
201.64	5884.11	5884.78
196.59	5883.38	5884.71
189.88	5881.73	5884.81
184.22	5879.62	5884.84
174.43	5878.42	5884.85
169.52	5877.58	5884.85
162.35	5877.79	5884.85
156	5877.21	5884.85
149.7	5877	5884.85
141.2	5876.73	5884.85
128.54	5876.48	5884.85
117.73	5875.33	5884.84
111.49	5875.09	5884.83
109.49	5875.14	
108.49	5875.18	5878.23
100.49	5875.13	5877.71
92.49	5874.78	5877.19
91.48	5874.37	5872.73
77.04	5873.3	5872.87
75.55	5872.6	5872.4
62.43	5872.57	5872.57
57	5871.36	5871.36
51.46	5871.26	5871.26
41.23	5871.19	5871.19
29.3	5870.45	5870.45
10.15	5869.34	5869.34

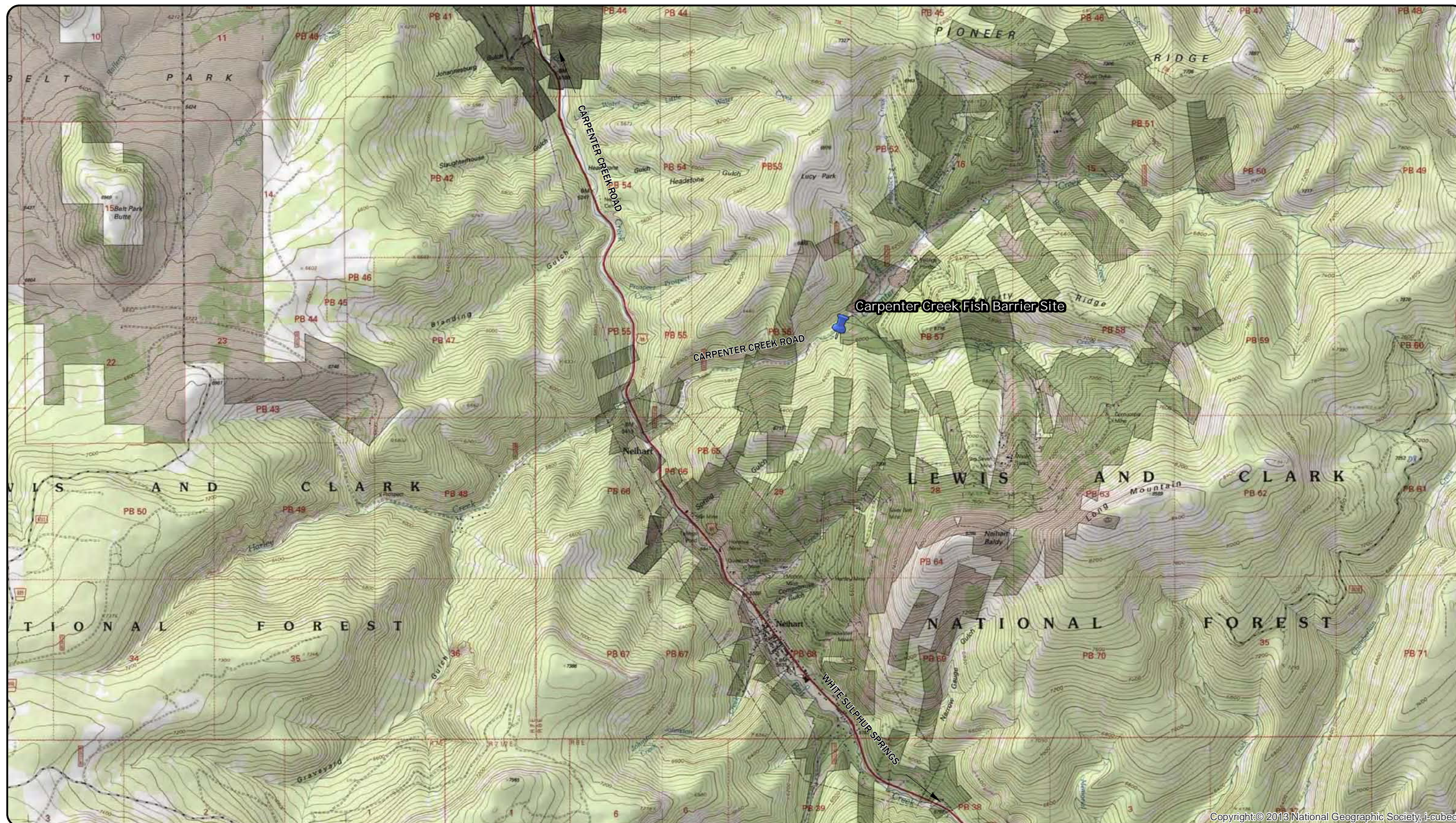
Discussion

The proposed barrier is located approximately 85 ft downstream of the existing natural channel drop feature.


Model simulations indicate that the backwater elevations will extend approximately 30 feet upstream of the existing rock drop (115 feet upstream of the fish barrier) for both the 2-year and 50-year flow events. Proposed simulation results also show that the water surface will be raised approximately 0.4 feet above the existing rock drop during the 2-year event and approximately 1.2 feet above the existing rock drop during the 50-year event.

In summary, this hydraulic analysis indicates that construction of a barrier at this location is estimated to have no impacts to upstream infrastructure or access roads, is located in an incised, narrow location, has good access and is a feasible location for a fish barrier. Additionally, Montana's Dam Safety Law states that a structure that impounds 50 acre-feet or more is considered a hazard and must be permitted as a jurisdictional structure. Pioneer estimates that in the worst case scenario (during the 100-year flood event and before the area upstream of the structure has filled with sediment) this structure will impound less than 1 acre-foot and is therefore not considered a jurisdictional structure.

Figures



DISPLAYED AS:
PROJECTION/ZONE: NAD83 UTM ZONE 12N
DATUM: NAD83
UNITS: METERS
SOURCE: PIONEER/NED/NHD



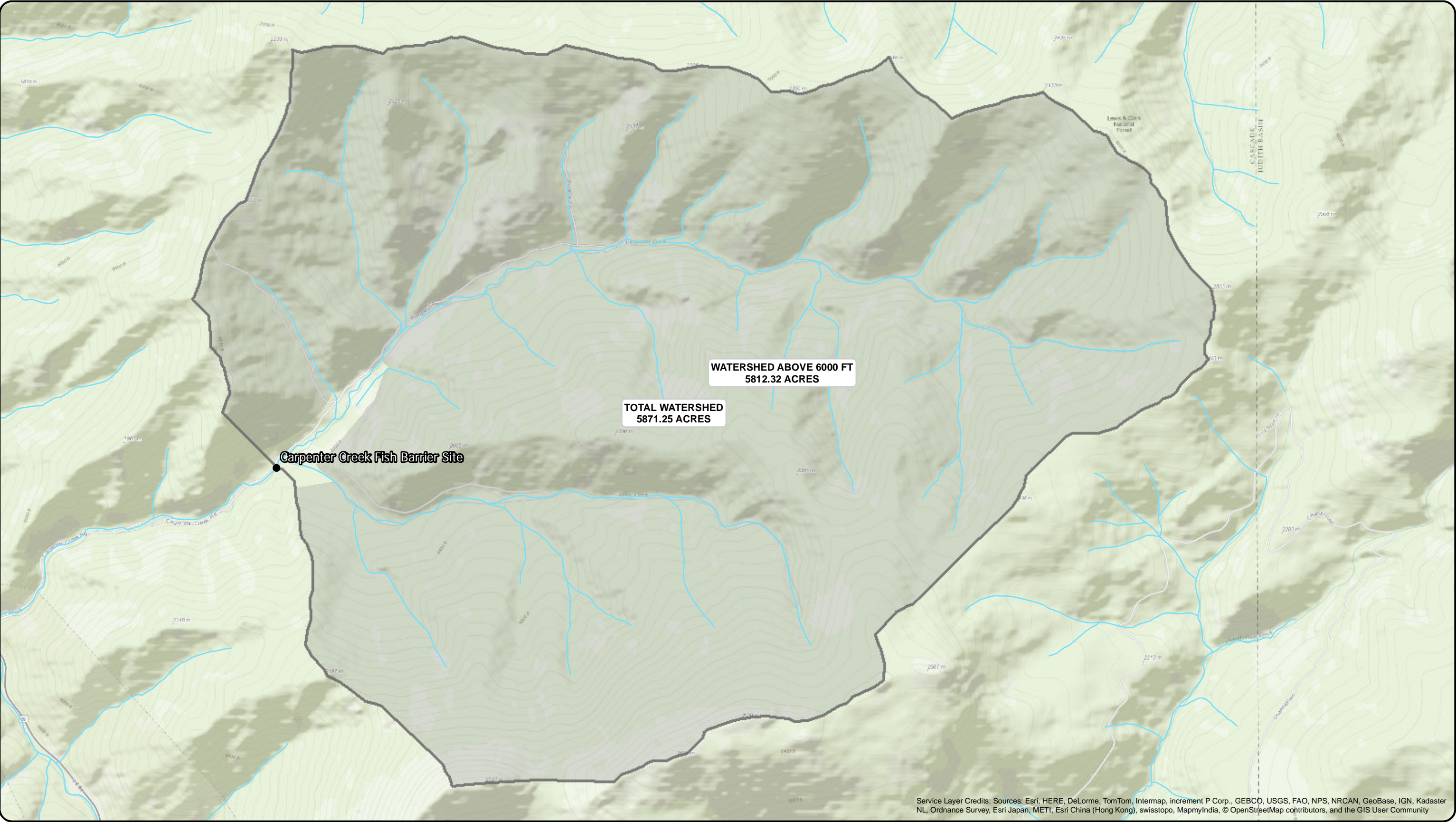
0 1,500 3,000 6,000
Feet

FIGURE 1





CARPENTER CREEK SITE LOCATION

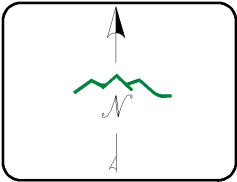
DATE: 1/16/2015



Service Layer Credits: Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

LEGEND

-  Total Watershed
-  Watershed Above 6000'



DISPLAYED AS:
PROJECTION/ZONE: NAD83 UTM ZONE 12N
DATUM: NAD83
UNITS: METERS
SOURCE: PIONEER/NED/NHD/NAIP 2013

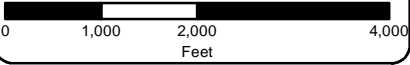
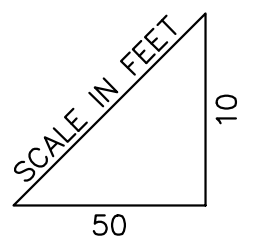
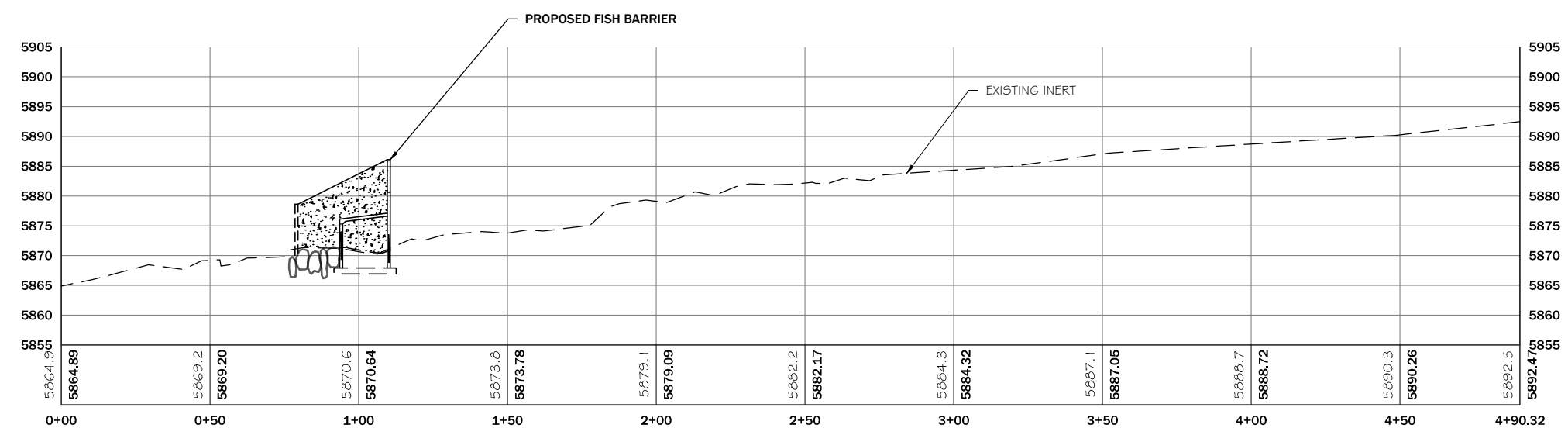
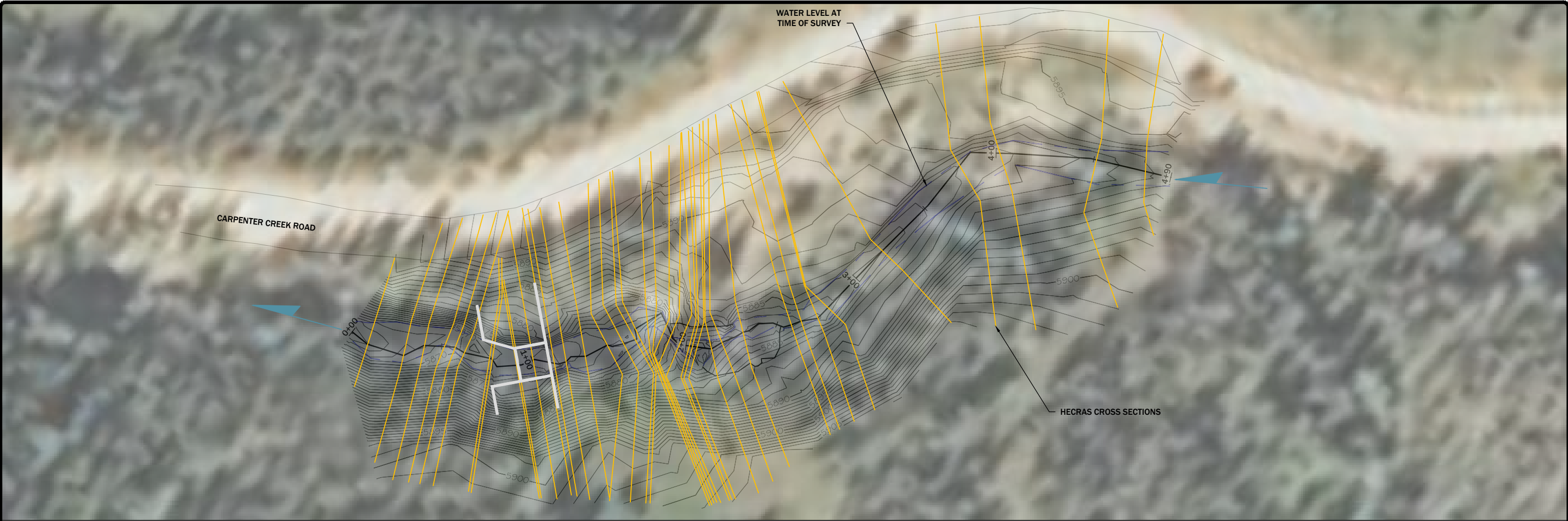


FIGURE 2



**CARPENTER CREEK
WATERSHED
BOUNDARY**

DATE: 1/16/2015



DISPLAYED AS:

COORD SYS/ZONE: MSP NAD83

DATUM: NAVD88

UNITS: INT. FEET

SOURCE: PIONEER/NAIP 2013

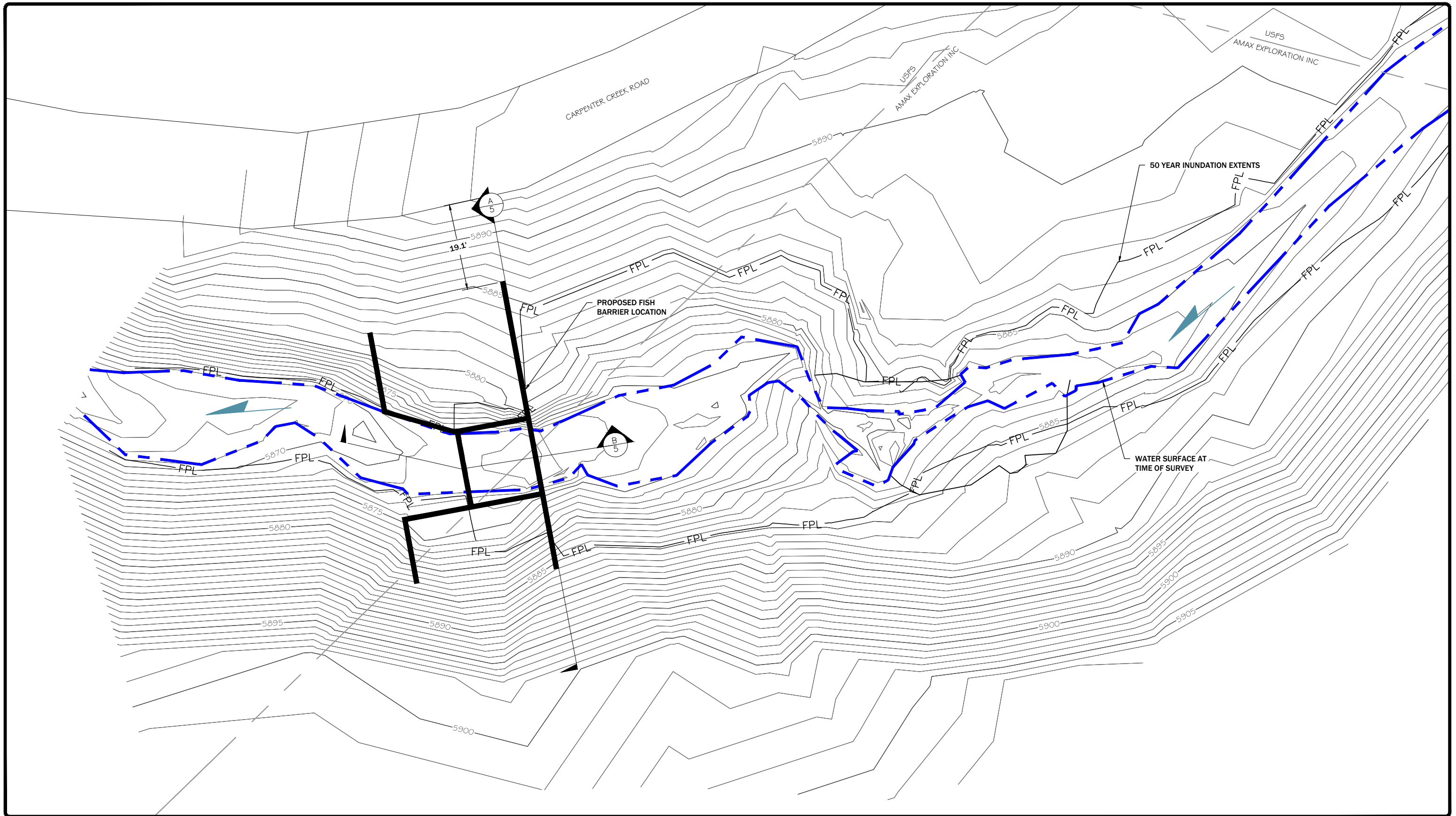
SCALE IN FEET


FIGURE 3

CARPENTER CREEK
EXISTING CONDITION/
HECRAS CROSS SECTION
PLAN & PROFILE

PIONEER
 TECHNICAL SERVICES, INC.
 106 PRONGHORN TRAIL, SUITE A
 BOZEMAN, MONTANA 59718
 (406) 388-8578

DATE: 2/6/15






DISPLAYED AS:
COORD SYS/ZONE: MSP NAD83
DATUM: NAVD88
UNITS: INT. FEET
SOURCE: PIONEER/NAIP 2013

SCALE IN FEET

0 10 20

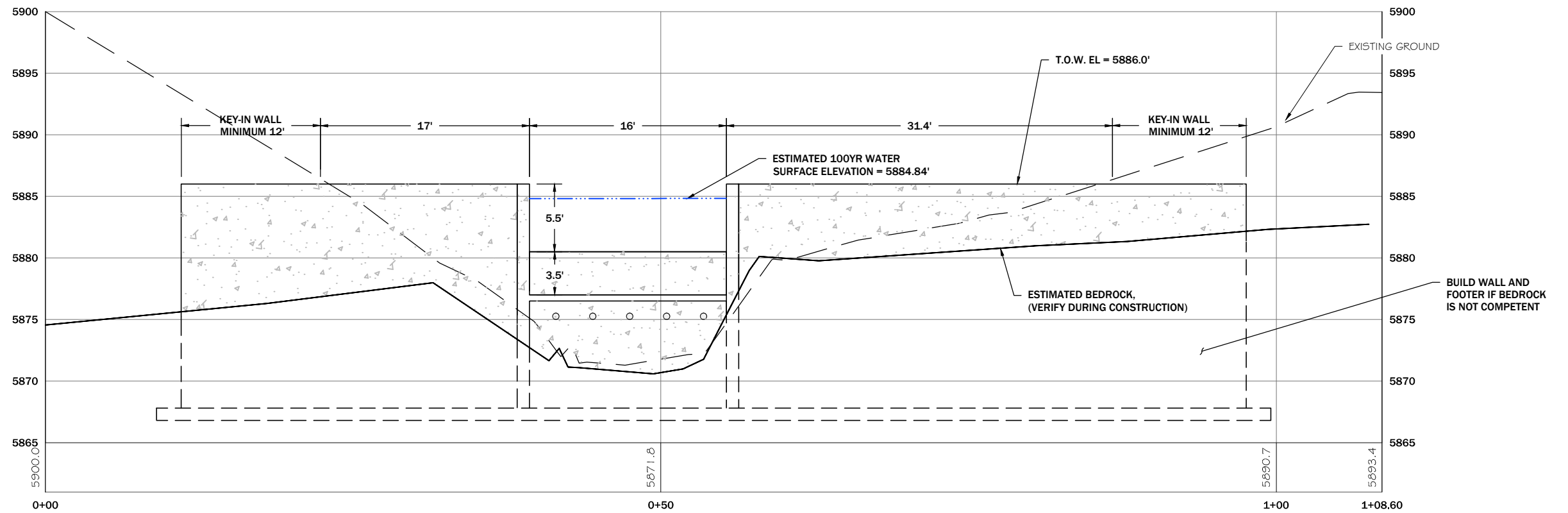
FIGURE 4



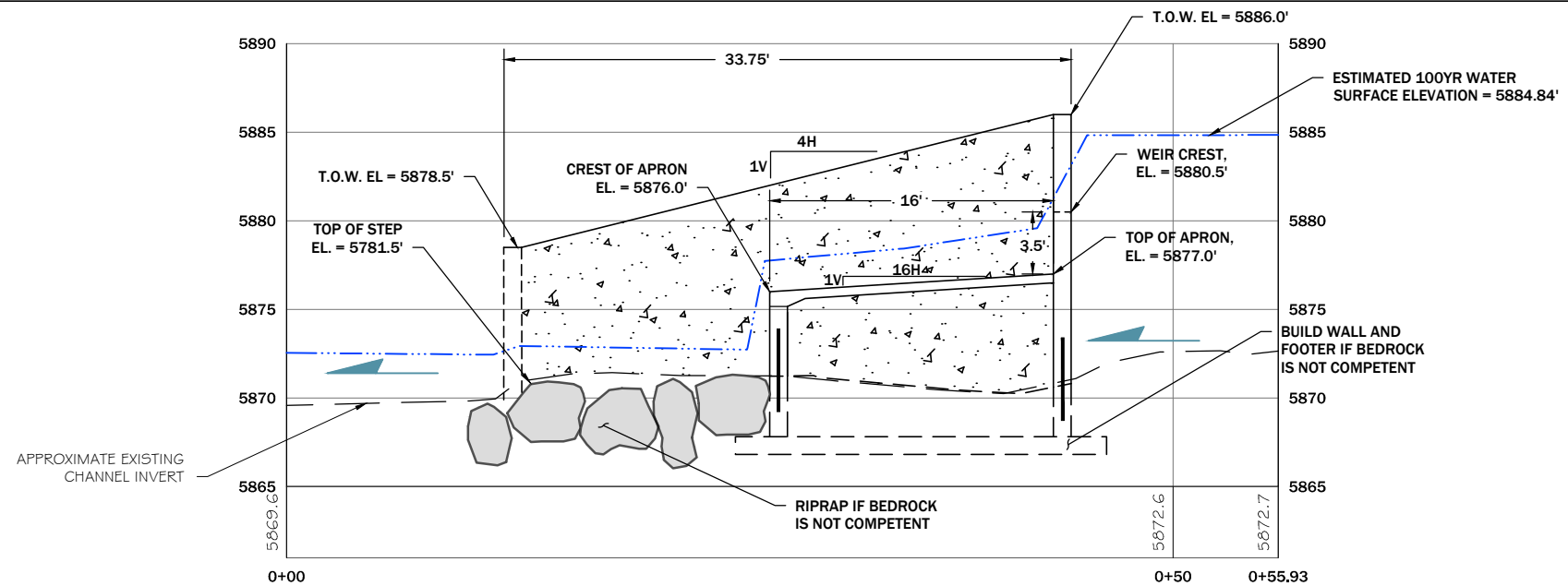
PIONEER
TECHNICAL SERVICES, INC.
106 PRONGHORN TRAIL, SUITE A
BOZEMAN, MONTANA 59718
(406) 388-8578

CARPENTER CREEK
PROPOSED
FISH BARRIER
PLAN VIEW

DATE: 2/13/15



A
4 FISH BARRIER SECTION
SCALE: 1" = 10'



B
4 FISH BARRIER PROFILE
SCALE: 1" = 10'

COORD SYS/ZONE:	NA
DATUM:	NA
UNITS:	FEET
SOURCE:	PIONEER

SCALE IN FEET

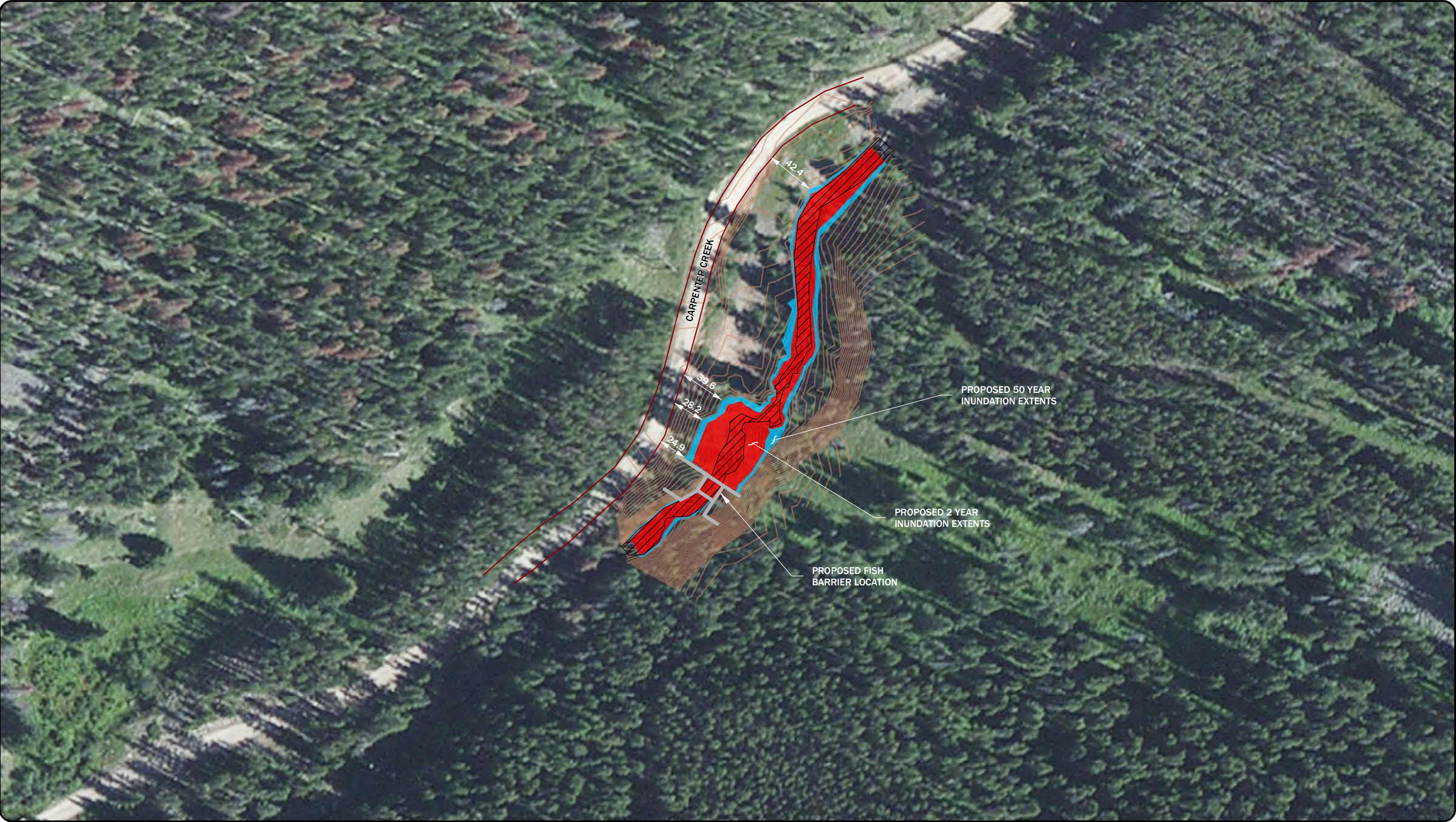
0 5 10

FIGURE 5

PIONEER
TECHNICAL SERVICES, INC.
106 PRONGHORN TRAIL, SUITE A
BOZEMAN, MONTANA 59718
(406) 388-8578

**CARPENTER CREEK
PROPOSED
FISH BARRIER
PROFILE &
CROSS SECTION**

DATE: 2/6/15



LEGEND

- Water at time of Survey
- 2yr Inundation
- 50yr Inundation
- 1' Contours

DISPLAYED AS:
PROJECTION/ZONE: NAD83 UTM ZONE 12N
DATUM: NAD83
UNITS: METERS
SOURCE: PIONEER/ESRI WORLD IMAGERY
LAST UPDATED 12/2014

0 40 80 160
Feet

FIGURE 6

**CARPENTER CREEK
INUNDATION
PLAN VIEW**

DATE: 2/13/2015